F1 003

Assessment of the Sacramento-San Joaquin River Delta as Habitat for Production of the Food Resources that Support Fish Recruitment

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This proposal describes a comprehensive assessment of the production, import, utilization, and export of the organic matter that serve as food for small aquatic organisms, such as copepods and mysid shrimp, that are the food resource for fish in their early life stages. The transfer of nutritive material among the biota at the lower trophic levels, from phytoplankton and detritus to small invertebrates and immature fish, represents one of the most critical sets of ecosystem functions in the Sacramento-San Joaquin Delta. These functions ultimately determine, and potentially limit the population growth of fishes in the Delta. Our project is designed to provide the scientific basis for judging how specific restoration actions can improve these ecosystem functions. It is motivated by the perspective of Herbold et al.[15] *"Developing an understanding of the estuary as an ecosystem is important to restore the healthy fisheries that the estuary has supported in the past. Development of a general, descriptive model of the aquatic habitats and resources of the Bay and Delta is necessary for coordinated and comprehensive management."* Our goal is to provide the information required to understand how different Delta habitats support the growth (secondary production) of the small aquatic invertebrates that are forage for the priority species of fish such as Delta smelt, longfin smelt, Sacramento splittail, and young striped bass. This information will be developed through completion of five related tasks that include: measurements of food quantity/quality and sources, compilation of budgets of food production and losses, analysis of long-term IEP measures of plankton populations, development of a numerical model of phytoplankton and nutrient dynamics in the Delta, and development of a synthesis of results to define the capacity of Delta habitats for supporting secondary production, with estimates of how that capacity would be changed by specific restoration actions.

Justification

The 1994 Bay-Delta accord was prompted by concerns about the dramatic declines of living resources that have occurred in the Sacramento-San Joaquin River Delta in recent decades. Progressive population declines of striped bass, white catfish, threadfin shad, longfin smelt, and Sacramento splittail have been observed since the 1970's. Some migratory (Chinook salmon) and resident (Delta smelt) fish have reached alarmingly small population levels, prompting protection under state and federal laws for endangered species. The green sturgeon is designated a species of concern by DFG. Two once-abundant species, the Sacramento perch and thicktail chub, are now extinct. The simultaneous and large declines of so many different species is now interpreted as a compelling "*indicator of broad problems with the estuarine environment, especially in the Delta*"[3]. CALFED agencies now face the complex challenge of implementing a long-term restoration program to solve these problems. One goal is to identify a suite of restoration actions to enhance the likelihood that populations of these living resources will return to levels observed in prior decades. Our project was designed to provide the scientific basis for restoration actions that can be taken to promote the production of the small lower-trophic-level invertebrate organisms that are utilized as forage by these fish at some period of their life cycles.

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Budget

This project is planned as a three-year cooperation between the U.S. Geological Survey (USGS), University of California-Davis (UCD), Stanford University, and Virginia Institute of Marine Science (VIMS). CALFED support will be supplemented by the USGS, with cost-sharing as follows:

	1998	1999	2000
Request to CALFED	517K	490K	393K
USGS Contribution	244K	283K	220K

Applicant Qualifications

This project is a team effort between investigators having a long history of involvement in Bay-Delta issues, and young investigators who are pioneering new techniques for assessing food quality and utilization in aquatic ecosystems. Project coordinator is James Cloern, a USGS biologist who has studied diverse aspects of the Bay-Delta ecosystem for over two decades. Dr. Michael Brett is Research Associate at UCD with expertise in plankton foodwebs. Dr. Elizabeth Canuel is Assistant Professor at VIMS, with expertise in the use of biomarkers to identify sources of organic matter in estuaries. Brian Cole is a USGS biologist who has studied plankton ecology of San Francisco Bay for over two decades. Dr. Alan Jassby is a Professional Research Ecologist at UCD, with expertise in mathematical tools for identifying patterns and causes of ecosystem variability. Dr. Jeffrey Koseff is Professor and Chair of the Department of Civil Engineering, Stanford University, with expertise in environmental fluid mechanics. Dr. Stephen Monismith is Associate Professor in the same department, with expertise in lake and estuarine hydrodynamics. Dr. Dörthe Müller-Navarra is Research Associate at UCD with expertise in techniques for assessing linkages between primary and secondary production. Drs. Cloern, Jassby, and Monismith are members of the Science Advisory Group to the IEP. This team has a rich history of collaborative science and publication. Examples include:

Canuel, E.A., Cloern, J.E., Ringelberg, D., Guckert, J., and Rau, G., 1995. Molecular and isotopic tracers used to understand sources of organic matter and trophic relationships in the San Francisco Bay estuary: Limnology and Oceanography, v. 40, p. 67-81.

Cole, B.E., and Cloern, J.E., 1984. Significance of biomass and light availability to phytoplankton productivity in San Francisco Bay: Marine Ecology- Progress Series, v. 15, page 15-24.

Jassby, A.D., W.J. Kimmerer, S.G. Monismith, C. Armor, J.E. Cloern, T.M. Powell, J.R. Schubel, and T.J. Vendlindski. 1995 Isohaline position as a habitat indicator for estuarine populations. Ecological Applications 5:272-289.

Koseff, J.R., Holen, J.K., Monismith, S.G., and Cloern, J.E., 1993.The effects of vertical mixing and benthic grazing on phytoplankton populations in shallow turbid estuaries. Journal of Marine Research, 51: 1-26, 1993.

Data Evaluation

Data and model analyses and interpretations will be subjected to the rigorous peer-review required for publication in international scientific journals, such as those listed above.

Local Support/Coordination with other Programs

This project will utilize laboratory and computing facilities and logistical support provided by the USGS in Menlo Park, Division of Environmental Studies at UC-Davis, and Department of Civil Engineering at Stanford University. Sampling will be coordinated with the IEP compliance monitoring. Proposed new measurements will complement those made with support from the USGS Toxic Substances Hydrology Program and IEP Contaminants Work Team. Model development will build upon numerical models supported by grants to Stanford from NSF.